PATENT ABSTRACTS OF JAPAN

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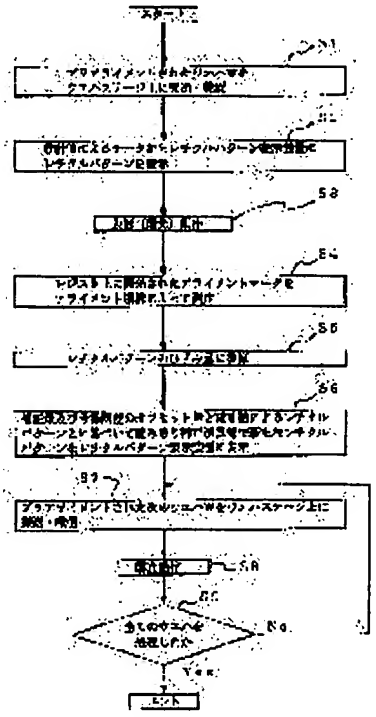
(54) EXPOSURE METHOD AND MANUFACTURE OF SEMICONDUCTOR DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide an exposure method, wherein a reticle pattern can be directly drawn from design data and exposure is performed by correcting the reticle pattern with mesured distortion amount, and a manufacturing method of a semiconductor device which uses the exposure method.

SOLUTION: In this exposure method, a display means which displays a reticle pattern on the basis of stored design data is irradiated with exposure light, and a pattern is formed on a photosensitive substrate. That is, the distortion of a pattern formed on the photosensitive substrate is measured (S4). On the basis of measured distortion, correction corresponding to the distortion is added (S5) to design data to be displayed on a displayed means, and a reticule pattern is displayed (S6). The reticle pattern to which correction is applied is irradiated, and a pattern is printed on the photosensitive substrate (S8). since the reticle pattern is displayed by correcting the design data of the pattern with a distortion amount measured by an alignment mechanism, alignment is enabled without mechanically correcting the reticle pattern.



LEGAL STATUS

[Date of request for examination]

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[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

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PRIOR ART

[Description of the Prior Art] As everyone knows, the aligner used for manufacture of a semiconductor device uses the reticle in which the circuit pattern was formed for a glass substrate, and is carrying out the exposure imprint of the pattern on the wafer which carried out contraction projection of what illuminated this by the illumination-light study system according to projection optics, and applied the resist. Drawing 7 is drawing showing the outline of the conventional aligner, and the block has shown each element. In drawing 7 , a required reticle is chosen from the reticle swap device 2 which carried out the a large number (1-n) receipt of the reticle by which the circuit pattern was formed in the glass substrate according to the instruction signal from a terminal 3, and an aligner 1 is equipped with an aligner 1. In case a semiconductor device is manufactured, a required reticle is chosen from the reticle swap device 2, and many reticle patterns lay on top of the same wafer, and are exposed. Namely, it must burn by carrying out the exposure imprint of the one reticle pattern at the resist film on a wafer, applying a resist, and choosing and putting another reticle on a wafer again, after a predetermined process.
[0002] It is important for the fundamental engine performance required of an aligner to excel in resolution, dimensional accuracy, doubling precision, etc. and that a throughput (throughput) is large for productivity. Therefore, in the conventional aligner, it is exposing exchanging many reticles and there is a limitation in improvement in a throughput.
[0003] The aligner which used ********** which can rewrite a reticle pattern as an aligner which cancels such a technical problem is proposed. If this kind of aligner is explained with reference to drawing 8 (the block has shown each element) The illumination-light study system 4 and the liquid crystal display 5 of the transparency mold illuminated by the illumination-light study system 4, The projection optics 6 which projects the reticle pattern formed in the liquid crystal display 5, The wafer stage 7 in which a wafer is laid, and the wafer stage control system 8 for moving the wafer stage 7 in the XY direction, It consists of a control unit 9 for controlling an aligner, a display control 10 which controls the contents of a display of a liquid crystal display 5, and a wafer conveyance system 11 which makes a wafer stage convey a wafer.
[0004] Moreover, the aligner using the transparency mold liquid crystal display as a liquid crystal display which displays a reticle pattern is indicated by JP,9-17719,A.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the exposure approach by the aligner which can form the reticle pattern of arbitration in indicating equipments, such as a liquid crystal display, and the manufacture approach of the semiconductor device by such exposure approach in detail about the exposure approach and the manufacture approach of a semiconductor device. [Description of the Prior Art] As everyone knows, the aligner used for manufacture of a semiconductor device uses the reticle in which the circuit pattern was formed for a glass substrate, and is carrying out the exposure imprint of the pattern on the wafer which carried out contraction projection of what illuminated this by the illumination-light study system according to projection optics, and applied the resist. Drawing 7 is drawing showing the outline of the conventional aligner, and the block has shown each element. In drawing 7 , a required reticle is chosen from the reticle swap device 2 which carried out the a large number (1-n) receipt of the reticle by which the circuit pattern was formed in the glass substrate according to the instruction signal from a terminal 3, and an aligner 1 is equipped with an aligner 1. In case a semiconductor device is manufactured, a required reticle is chosen from the reticle swap device 2, and many reticle patterns lay on top of the same wafer, and are exposed. Namely, it must burn by carrying out the exposure imprint of the one reticle pattern at the resist film on a wafer, applying a resist, and choosing and putting another reticle on a wafer again, after a predetermined process.
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[0003] The aligner which used ********** which can rewrite a reticle pattern as an aligner which cancels such a technical problem is proposed. If this kind of aligner is explained with reference to drawing 8 (the block has shown each element) The illumination-light study system 4 and the liquid crystal display 5 of the transparency mold illuminated by the illumination-light study system 4, The projection optics 6 which projects the reticle pattern formed in the liquid crystal display 5, The wafer stage 7 in which a wafer is laid, and the wafer stage control system 8 for moving the wafer stage 7 in the XY direction, It consists of a control unit 9 for controlling an aligner, a display control 10 which controls the contents of a display of a liquid crystal display 5, and a wafer conveyance system 11 which makes a wafer stage convey a wafer.
[0004] Moreover, the aligner using the transparency mold liquid crystal display as a liquid crystal display which displays a reticle pattern is indicated by JP,9-17719,A.
[0005]
[Problem(s) to be Solved by the Invention] In the aligner of drawing 8 , it is indicated that a reticle pattern is formed in a liquid crystal display 5 with a display control 10, a liquid crystal display 5 is illuminated by the illumination-light study system 4, and a reticle pattern can be burned on a wafer. When manufacturing the same semiconductor device using two or more aligners, the difference between

number machines occurs [the difference or baking precision of a property of each equipment proper] also in meteorological conditions, such as an atmospheric pressure. It is necessary to take into consideration the amount of strains by the amounts of offset, such as such a difference between number machines, thermal expansion, a level difference which are generated in heat treatment of the wafer generated in the camber and production process of the wafer itself, etc. The aligner which used the conventional liquid crystal display had the room of an improvement in improvement in resolution, doubling precision, etc. instead of the equipment in consideration of the error of the pattern and design value which were able to be burned on such a wafer.

[0006] It is the exposure approach which amends a reticle pattern with the amount of strains measured by the alignment device, and is exposed while this invention is made in view of the above-mentioned technical problem, enables it to form a reticle pattern in arbitration on the occasion of manufacture of a semiconductor device etc. and can carry out direct writing of the reticle pattern from a design data.

[0007]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, the exposure approach by invention concerning claim 1 By irradiating exposure light at a display means to display a reticle pattern based on the design data memorized The measurement process which measures the strain of the pattern formed in said induction substrate in the exposure approach which forms a pattern in an induction substrate; It is based on said measured strain. The display process which adds the amendment corresponding to said strain to the design data which should be displayed on said display means, and displays a reticle pattern; it is characterized by having irradiated the reticle pattern with which said amendment was added, and having the exposure process which forms a pattern in said induction substrate. Relative rotation with the pattern formed by preceding besides a gap of the scale factor between a reticle pattern and a projection pattern and a perpendicularity error is also included in the strain said here.

[0008] Thus, if constituted, right projection exposure can be performed, without amending a strain for a reticle pattern structural by displaying a reticle pattern on display means, such as a liquid crystal display, and the amount of strains measured and obtained according to the alignment device amending the design data of a pattern, and displaying a reticle pattern based on a design data.

[0009] The exposure approach by invention concerning claim 2 is based on the design data about the reticle pattern formed on a display means. The pattern formation process which forms a reticle pattern on said display means; by irradiating exposure light at the reticle pattern formed at said pattern formation process On an induction substrate, a pattern It is based on said measured strain. The measurement process which measures the strain between the pattern formed on the induction substrate at the exposure process and the; aforementioned exposure process to form, and the pattern which should be essentially formed in an induction substrate from said design data; said reticle pattern It is characterized by having the amendment process to amend and;.

[0010] Thus, with constituting, based on a design data, a reticle pattern is displayed on display means, such as a liquid crystal display, and a right pattern can be burned on an induction substrate, without amending the design data of a pattern, displaying on a display means and amending the amount of strains for a reticle pattern structural with the amount of strains measured and obtained with the formation process by an alignment device etc.

[0011] Moreover, the process at which an alignment mark is included by said reticle pattern, and the exposure approach by invention concerning claim 3 measures said strain is invention according to claim 1 or 2 characterized by measuring a strain from the location of the alignment mark formed in said induction substrate, and the alignment mark location which should be essentially formed in an induction substrate from said design data.

[0012] Thus, with constituting, according to an alignment device, the amount of strains is measured from the location of an alignment mark, and this amount of strains amends a design data, and it displays on a display means.

[0013] Moreover, the process which the exposure approach by invention concerning claim 4 is performed using the projection aligner which has the stage which said exposure process lays the

projection lens which projects said reticle pattern, and said induction substrate, and moves to two-dimensional, and measures said strain is invention according to claim 2 characterized by to use the aberration data which said projection lens has, and the perpendicularity data which said stage has.
[0014] Thus, if constituted, the aberration data which said projection lens has, and the perpendicularity data which said stage has can amend the amount of strains of the reticle pattern displayed on the display means.
[0015] Moreover, the semiconductor device manufacture approach by invention concerning claim 5 is manufacture about the semiconductor device using the exposure approach by the exposure approach according to claim 1 to 4 characterized by manufacturing a semiconductor device using said amended reticle pattern.
[0016] Thus, with constituting, while being able to form a reticle pattern by the design data, a design data can be amended in the amount of strains measured by the alignment device, and a semiconductor device can be manufactured.
[0017]
[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained with reference to a drawing. In addition, in each drawing, the same or the explanation which gave the same sign to the corresponding member and overlapped as much as possible is omitted mutually.
[0018] Drawing 1 is drawing showing the outline of the equipment for explaining 1 operation gestalt of this invention, and drawing where drawing 1 (A) displayed each component of equipment with a block, and (B) are the side-face (part cross section) Figs. of actual equipment. In this drawing, the control unit 11 containing a central control unit (CPU), the terminal (input section) 12 which inputs a control signal into a control unit 11, the reticle pattern storage 13 which memorizes the reticle pattern design data made binary, and an aligner 14 are included. It has illumination-light study system 14a including the light sources, such as a mercury lamp and excimer laser, etc., projection optics 14b containing the projection lens which projects a reticle pattern, and wafer stage 14c, and the aligner 14 is equipped with the reticle pattern display 16 which can form the reticle pattern of arbitration, and the alignment (alignment) device 15 while projecting a reticle pattern with illuminating by illumination-light study system 14a. Here, a reticle pattern design data is for example, CAD (Computer Aided Design) data.
[0019] Furthermore, the control device 11 is connected with the design data storage 18, online, etc. which memorized the design data changed and made binary with the digitizer 17. A digitizer 17 is equipment which changes into binary-ized data and creates a reticle pattern design data after creating a mask pattern from a pattern layout Fig., and this design data is memorized by the design data storage 18. The control device 11 is made as [input / from the design data storage 18 / a design data], in case a reticle pattern is formed.
[0020] When amendment is not required, a reticle pattern may be displayed on an indicating equipment 16 using the data from the reticle pattern store 13, and the reticle pattern store 13 and the design data storage 18 may be constituted in one.
[0021] Then, with reference to drawing 2 , the exposure approach which is 1 operation gestalt of this invention is explained. First, in step S1, the wafer W (wafer for measurement) which applied the resist to the wafer stage is conveyed, and it lays in the wafer stage of an aligner. Before this wafer W is conveyed on a wafer stage, the so-called PURIARAIMENTO which prepares a direction posture beforehand using a cage hula (orientation flat) etc. is performed.
[0022] Subsequently, it progresses to step S2, and with directions of a control device 11, a reticle pattern alignment mark is displayed with the reticle pattern display 16, and the reticle pattern display 16 is illuminated from an illumination-light study system according to the directions from a control device 11. If it does in this way, the alignment mark formed in the predetermined location of a reticle pattern and a reticle pattern will be projected on Wafer W, and a latent image will be made by the resist (S3). This alignment mark (latent image) is measured by the alignment device 15 (S4). Therefore, the amount of strains of a reticle pattern and a projection pattern can be measured. In measurement of this amount of strains, the aberration data which a projection lens has, and the perpendicularity data of a stage may be used.

[0023] Then, it progresses to step S5 and a reticle pattern design data is amended as an amount of amendments for correcting a reticle pattern design data for this amount of strains. Multiplication, addition, etc. make the amount of amendments a reticle pattern design data, and the data of the amended reticle pattern are created. Moreover, when offset has arisen between the number machines of each aligner, a reticle pattern design data is corrected based on the amount of offset of each aligner.
[0024] Furthermore it progresses to step S6, the amendment data of a reticle pattern are inputted into the reticle pattern display 16, and a reticle pattern is displayed.
[0025] And it progresses to step S7 and the wafer [PURIARAIMENTO / wafer / instead of the wafer W for measurement] W for products is laid on a stage.
[0026] Furthermore it progresses to step S8, it exposes to the sensitization side of the product wafer W, and a reticle pattern can be burned.
[0027] Next, it progresses to step S9 and judges whether all the product wafers W were processed, and when the wafer W which should still be processed remains, it returns to step S7, the following wafer W is laid on a wafer stage, and exposure is repeated.
[0028] When it is judged by step S9 that all the wafers W were processed, it means ending the exposure process of the 1st layer (end).
[0029] Thus, when performing a series of exposure with the same number machine, amendment of a reticle pattern is good per exposure of the wafer of two or more one lots at once.
[0030] When each field of a wafer can be burned for every single shot, in order to amend the camber after the heat treatment process of a wafer, expansion, etc., you may make it amend the amount of strains for alignment for every field by the exposure method which repeats a step-up repeat and can be burned in one wafer. In other words, the reticle pattern of a wafer may be amended, amending the amount of strains of the field before [one] exposing, and you may expose. Namely, steps S1-S6 may be performed for every single shot.
[0031] Also in the scan exposure also to the case of one-shot exposure, the above approach is applicable.

[0032] Next, the process which exposes a two-layer eye or subsequent ones to Wafer W with reference to drawing 3 is explained. Although the pattern of each class may always be amended on the basis of a design data to Wafer W when carrying out projection exposure of the pattern of two or more layers, it is more efficient to take the approach of exposing below a two-layer eye on the basis of the 1st layer actually exposed with some errors with the design value. Drawing 3 is the flow Fig. having shown such an approach.
[0033] Steps S1-S5 of drawing 2 or the process to S6 is finished also about the reticle pattern of the 2nd layer, using the wafer W for a trial as a premise of the approach of drawing 3 , and the amount of strains of the number machine which exposes a two-layer eye is calculated beforehand.
[0034] The wafer W with which the 1st layer was already exposed, and it conveys and lays on a wafer stage (step S21). [among drawing 3]
[0035] Next, it progresses to step S22 and the alignment mark currently formed with the pattern of the 1st layer on the wafer W is measured according to an alignment device. Although it must almost be without error since the 1st layer amends a reticle pattern and projection exposure is carried out at the process shown in drawing 2 , few errors which may still be produced are measured.
[0036]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the schematic diagram of the aligner for explaining the exposure approach of this invention.
[Drawing 2] It is the flow Fig. showing the outline of 1 operation gestalt of the exposure approach of this invention.
[Drawing 3] It is the flow Fig. showing the outline of the approach of exposing below a two-layer eye with 1 operation gestalt of the exposure approach of this invention.
[Drawing 4] It is the schematic diagram having shown each part for the aligner for explaining the exposure approach of this invention with a block.
[Drawing 5] It is the flow Fig. showing the manufacture approach of the semiconductor device of this invention.
[Drawing 6] It is the flow Fig. showing the manufacture approach of the semiconductor device of this invention.
[Drawing 7] It is the schematic diagram having shown each part for the conventional aligner with a block.
[Drawing 8] It is the schematic diagram having shown each part for the conventional aligner with a block.
[Description of Notations]
11 Control Unit
11a The amount operation part of amendments
11b Image data storage section
11c Image data forwarding section
12 Terminal
13 Reticle Pattern Storage
14 Aligner
14a Illumination-light study system
14b Projection optics
14c Wafer stage
15 Alignment Device
16 Reticle Pattern Display
17 Digitizer
18 Design Data Storage
19 Wafer Transport Device
20 Wafer Stage Controlled-Variable Operation Means

[Translation done.]

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EFFECT OF THE INVENTION

[Effect of the Invention] Since it has the process which amends a design data based on the strain measured at the process which measures a strain while being able to form the reticle pattern in arbitration and being able to carry out the direct writing of the reticle pattern from a design data, since a display means to display a reticle pattern in this invention based on a design data was used, and displays a reticle pattern as mentioned above, a reticle pattern can be corrected easily and exact and quick exposure is attained. Moreover, since such an exposure approach is used, the throughput of manufacture of a semiconductor device can be raised.

[Translation done.]

JAPANESE [JP,11-045851,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS DESCRIPTION OF DRAWINGS DRAWINGS

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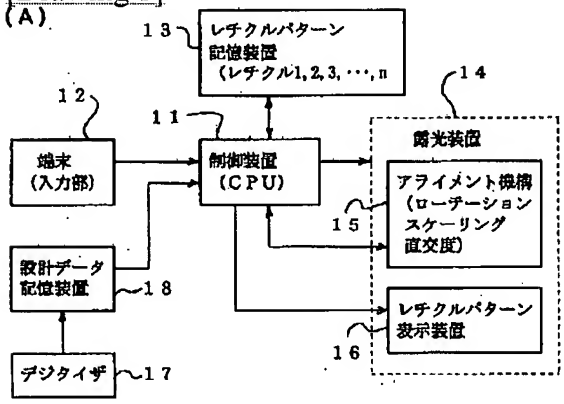
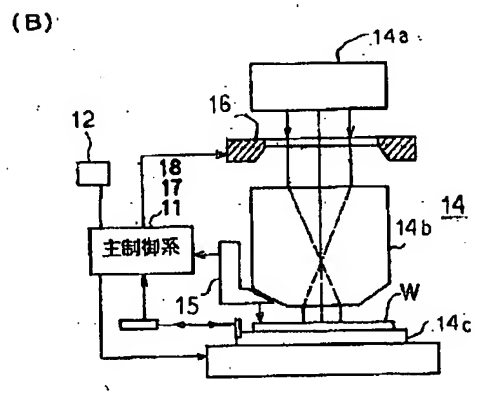
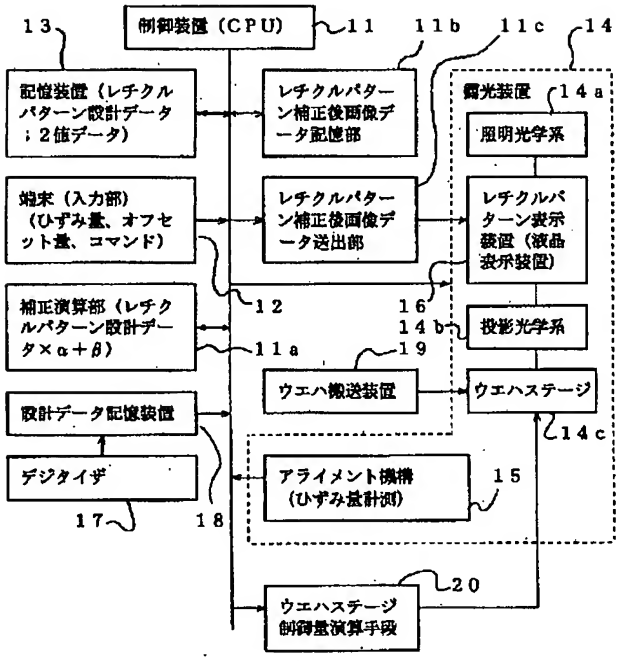
DRAWINGS

[Drawing 1]

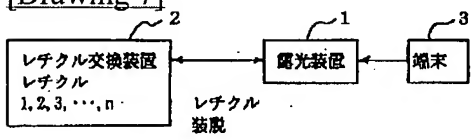




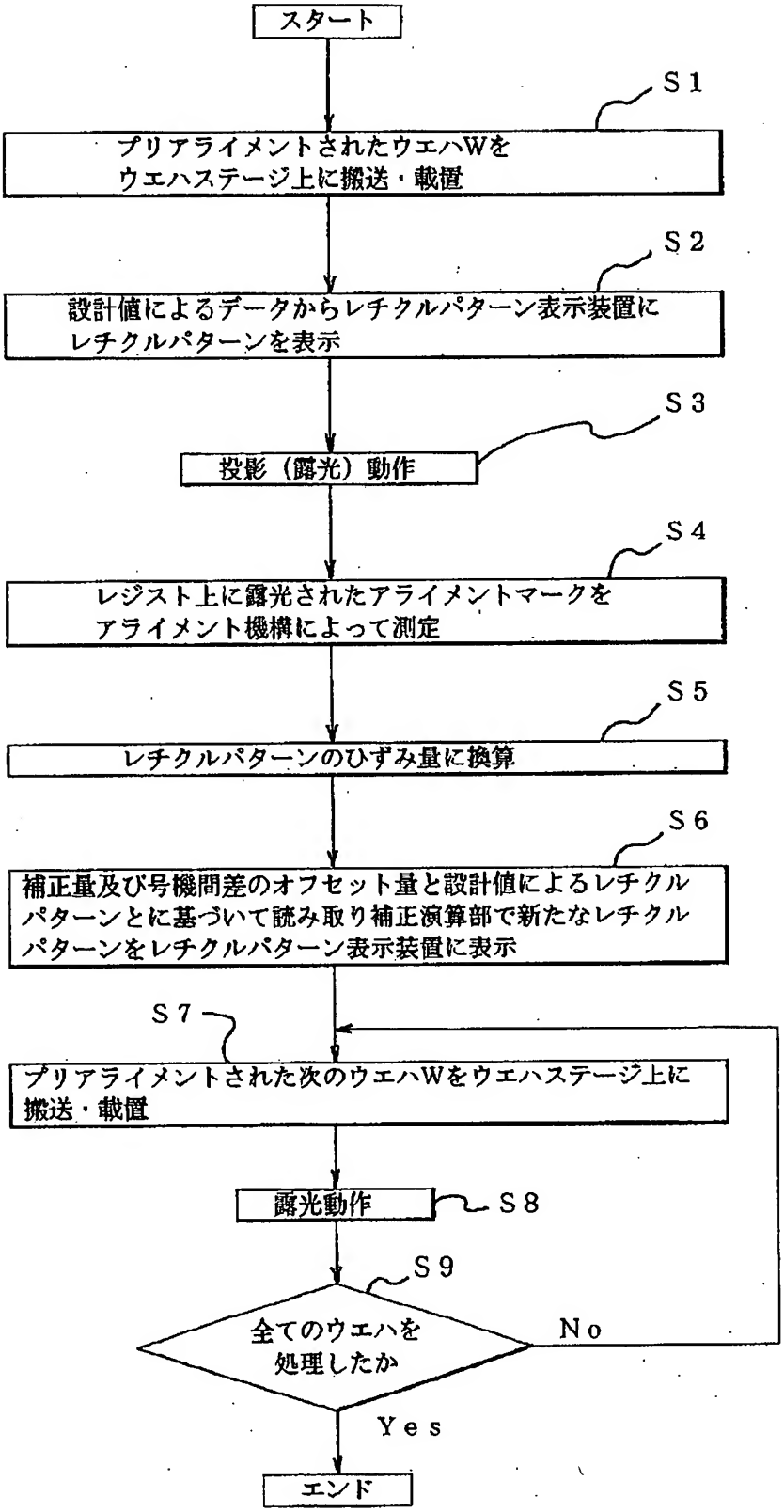
[Drawing 4]



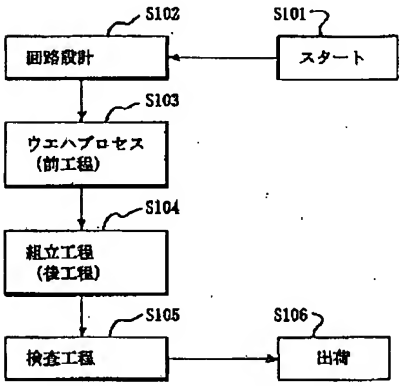
[Drawing 7]



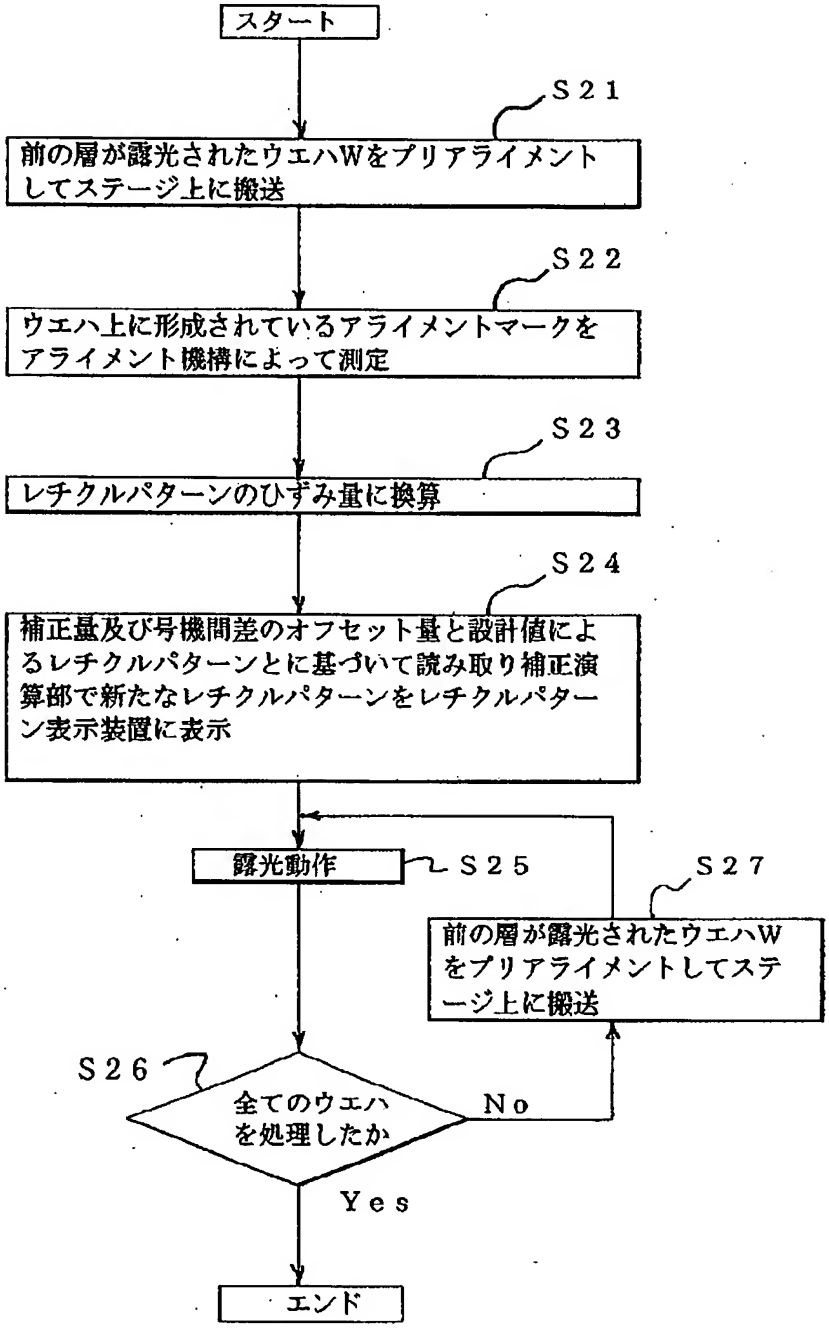
[Drawing 2]


スタート
S1
プリアライメントされたウエハWを
ウエハステージ上に搬送・載置
S2
設計値によるデータからレチクルパターン表示装置に
レチクルパターンを表示
S3
投影（露光）動作
S4
レジスト上に露光されたアライメントマークを
アライメント機構によって測定
S5
レチクルパターンのひずみ量に換算
S6
補正量及び号機間差のオフセット量と設計値によるレチクル
パターンとに基づいて読み取り補正演算部で新たなレチクル
パターンをレチクルパターン表示装置に表示
S7
プリアライメントされた次のウエハWをウエハステージ上に
搬送・載置
露光動作
S8
S9
全てのウエハを
処理したか
No
Yes
エンド

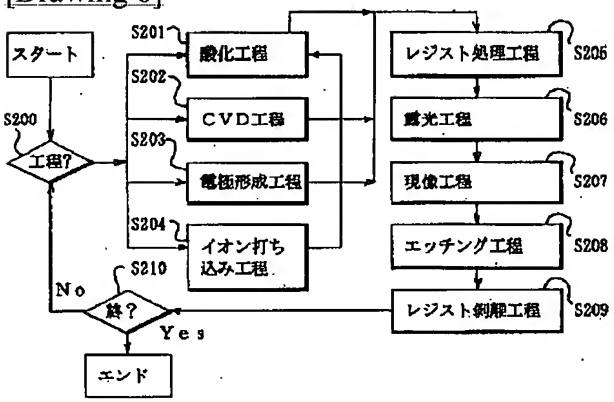
[Drawing 5]


S102
S101
回路設計
スタート
S103
ウエハプロセス
(前工程)
S104
組立工程
(後工程)
S105
S106
検査工程
出荷

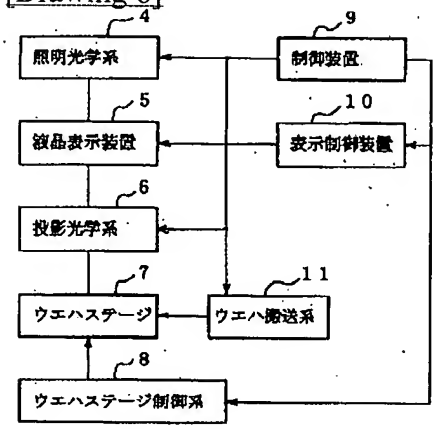
[Drawing 3]


スタート
S21
前の層が露光されたウエハWをプリアライメントしてステージ上に搬送
S22
ウエハ上に形成されているアライメントマークをアライメント機構によって測定
S23
レチクルパターンのひずみ量に換算
S24
補正量及び号機間差のオフセット量と設計値によるレチクルパターンとに基づいて読み取り補正演算部で新たなレチクルパターンをレチクルパターン表示装置に表示
露光動作
S25
S27
前の層が露光されたウエハWをプリアライメントしてステージ上に搬送
S26
全てのウエハを処理したか
No
Yes
エンド

[Drawing 6]


スタート
S200
工程?
S201
酸化工程
S202
CVD工程
S203
電極形成工程
S204
イオン打ち込み工程
S205
レジスト処理工程
S206
露光工程
S207
現像工程
S208
エッチング工程
S209
レジスト剥離工程
S210
終?
No
Yes
エンド

[Drawing 8]



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CLAIMS

[Claim(s)]
[Claim 1] By irradiating exposure light at a display means to display a reticle pattern based on the design data memorized The measurement process which measures the strain of the pattern formed in said induction substrate in the exposure approach which forms a pattern in an induction substrate, The display process which adds the amendment corresponding to said strain to the design data which should be displayed on said display means based on said measured strain, and displays a reticle pattern, The exposure approach characterized by having irradiated the reticle pattern with which said amendment was added, and having the exposure process which forms a pattern in said induction substrate.
[Claim 2] The pattern formation process which forms a reticle pattern on said display means based on the design data about the reticle pattern formed on a display means, By irradiating exposure light at the reticle pattern formed at said pattern formation process The measurement process which measures the strain between the exposure process which forms a pattern on an induction substrate, and the pattern formed on the induction substrate at said exposure process and the pattern which should be essentially formed in an induction substrate from said design data, The exposure approach characterized by having the amendment process which amends said reticle pattern based on said measured strain.
[Claim 3] The process which an alignment mark is included in said reticle pattern, and measures said strain is the exposure approach according to claim 1 or 2 characterized by measuring a strain from the location of the alignment mark formed in said induction substrate, and the alignment mark location which should be essentially formed in an induction substrate from said design data.
[Claim 4] The process which said exposure process is performed using the projection aligner which has the stage which lays the projection lens which projects said reticle pattern, and said induction substrate, and is moved to two-dimensional, and measures said strain is the exposure approach according to claim 2 characterized by using the aberration data which said projection lens has, and the perpendicularity data which said stage has.
[Claim 5] The semiconductor device manufacture approach by the exposure approach according to claim 1 to 4 characterized by manufacturing a semiconductor device using said amended reticle pattern.

[Translation done.]